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VOL. XVIII JANUARY, 1931 No. 1

EDITORIAL

(Editorial by F. C. Mesle, former Editor of the REVIEW *and active member of Rochester Branch.)*

CHECK AND DOUBLE CHECK

As we approach the New Year, we are reminded that it is inventory time, in fact, we are not allowed to forget this important event. How can we forget with all the extra work that we are called upon to do at this time of year.

Inventory is a check on the year's progress. We are anxious to learn if we have made a profit, if we have been worth our salt during the activities of the year. This check and double check on profit is necessary for the healthy growth of every concern.

Profit, however, is not the only important thing in life that should be checked up, more important is life itself, and the factors that contribute toward making life worth the living. A life to be worth living must be useful and happy, not just good, but good for something. The value of a man's life is determined by the contribution he makes to the betterment of the world in which he lives and the size of his life, which in turn is measured by the size of the world into which he projects his life in which he carries on his work, or should we endeavor to measure a man by volume to determine his worth he could be measured by the height of his *ideals,* the depth of his convictions, the breadth of his sympathies and the length of his sacrifices.

With these values in mind, it may be worth our while to take a lesson from the famous Radio comedians who so frequently suggest that we check and double check to determine how much progress we have made, what profit as a result of our business endeavors, if progress and profit has not been what we want, then

look for the leaks, stop them, and plan to do better during the New Year.

And in the same way check and double check on the bigger business, the business of life, of living, of growing into bigger and better men in the various phases of life our lives may touch in the course of a year.

I started this editorial with the desire to apply the "checking" idea to the membership of the A. E. S. Now, then, just how big are we in the electroplating world in which we spend so much of our time? How deeply do we project our lives into our work, or into the lives of our fellow members in a helpful way? How high are our ideals for the future usefulness of the A. E. S. How deep are our convictions as to the value of our membership in the Society, and how broad are our sympathies for our fellow members, especially when up to their neck in plating problems and troubles, or how long our sacrifices in time, talent, knowledge, energy to keep the A. E. S. a useful on-going institution? How big are we as members? Let's check and double check—then determine to grow bigger and better during the year 1931. May it also be a Happy and Prosperous Year to you all.

COMMERCIAL CONTROL OF SILVER-PLATING

By A. E. Thurber

Read at the Washington, D. C. Convention, 1930

Silver plating varies so much in different industries that it is difficult to discuss its control without treating each case individually. There are, however, certain features common to all and these will be considered in this paper.

Silver plating control is very similar to that of other kinds of plating in many respects, and it is generally thought, and perhaps rightly, that silver plating is comparatively easy. Plating control is relative.—It is never perfected. Control considered good enough for today is out of date tomorrow. Therefore, provision should be made, not only for actual control, but for investigation and development of new ideas—work that is often called Research.

Control implies knowledge. In most cases lack of control is the price of ignorance, although the following familiar quotation from Shakespeare contradicts this. He says, "If to do were as easy as to know what were good to do, chapels would be churches and poor men's cottages rich men's palaces." This sentiment may be

applied to morals and ethics but it has no place in plating control.

It is not necessary to mention here that any plater who does not have access to a chemical and physical testing laboratory is working under disadvantage. With due respect for the so-called "Rule o' thumb" methods of control, these are not so good as was formerly thought, and never were.

Plating Departments are commonly connected with manufacturing plants and operated under the same management. In these plants, there is a field for a general control laboratory. Except in the larger industries, this laboratory may cover both control and research. Obviously, under these conditions, a laboratory can be more extensive than one entirely devoted to the plating department and, because of having general knowledge of processes throughout the plant, should be especially well adapted for assisting in plating control. This laboratory should hold relatively the same position in the organization as the departments in which it functions and preferably should be responsible to the same manager. For obtaining best results, the heads of the operating departments should become familiar with the kind of assistance which the laboratory is able to furnish. And the laboratory men must acquaint themselves with the practical problems of operating.

Control of plating usually extends well beyond the boundaries of the plating room. Among the various manufacturing operations are processes which, if not properly controlled, interfere with plating. A general control laboratory can be of great assistance to the plater by controlling these processes.

The chemical and physical properties of the base metal affect the deposit. It is necessary that the plater know the composition of the metal that he is expected to plate, since the processing has to be modified to fit different metals. For example, a cleaning process which is well adapted for iron or steel may be poorly suited for cleaning brass or white metal.

The surface finishing operations require control relative to the bearing which they have upon plating. This is frequently a delicate subject and the cause of controversy between platers and other departments. It is not uncommon to hear it said that any defect that cannot be seen with the naked eye should plate satisfactorily. Nevertheless it is true that microscopic specks of scale or other inclusions as well as fine scratches and flaws may be the cause of inferior or defective plating. This is not an alibi for the plater. On the contrary, proper standards of control of cleaning

and plating will do much towards overcoming such base metal defects. The control laboratory can render valuable assistance in preventing such base metal defects and also in determining what surfaces are suitable for plating.

Furnace temperatures and atmospheres must be controlled in the heat treating of metals, or this may be a source of trouble. Scale or oxides from these operations may be carried directly to plating or, if pickled off, the severe pickling required for excessive scale may leave the surface unfit for plating. The grain of certain metals grows coarse rapidly when annealed at too high temperature. For example, 18% nickel, 22% zinc and 64% copper alloy becomes coarse grained when heated above 1250 degrees Fahrenheit, or so as to test less than 40 Rockwell B. hardness. This coarse grain is especially undesirable for plating when this operation is preceded by pickling or etching, since the acids attack the metal in the grain boundary more rapidly than the rest of the metal, thus outlining the grains so that they may show distinctly after plating.

In forming, grinding, buffing and polishing, many kinds of oils and compounds are used. Some of these materials may be sufficiently good for these operations but are impossible to remove by the plating room cleaning solutions. Unfortunately, there is no universal cleaner which will dissolve all these compounds, so it is imperative that these materials be selected so as to fit the standard plating cleaning processes. Otherwise, expensive hand cleaning operations will become necessary.

Many other materials and supplies used throughout the plant must be carefully selected, such as chemicals used in plating and elsewhere, grits and abrasives for grinding and polishing, etc. These should be purchased on strict specifications and tested and inspected before being received into the plant.

Incidentally one of the most difficult supplies to control in silver-plating industries is the paper and box board for use in contact or close proximity to the silver. Sulphur is used in the manufacture of nearly all paper and more or less of this sulphur is left in the finished product. Unfortunately, this sulphur is in just the right state to react with silver to form silver sulphide tarnish. The exact amount of sulphur which a paper may contain and be satisfactory for this purpose is stated by some to be as low as .0004 of 1%. Paper containing this amount of sulphur is fair, but less is desirable.

The standard lead acetate chemical test for determining the sulphur content in paper is inadequate. In connection with this chemical test, the following practical test will give good results. This consists of wrapping several layers of the paper in question around a clean, freshly buffed piece of silver. This package is then slightly moistened and kept at a temperature of about 70 degrees Centigrade for 12 hours or longer. Paper that does not tarnish silver in this test is satisfactory.

It has been suggested that the use of carbon bisulphide in plating solutions causes silver to tarnish. Evidence for this is lacking. However, some of the materials used in finishing silver stimulate tarnish and these should be avoided.

To the casual observer, the cleaning process preparatory for plating looks simple and even uninteresting, but platers commonly consider this the most difficult part of the plating process. How difficult, depends upon many conditions which vary greatly in different plating departments. Let us consider the plater who receives his work direct from the making departments covered with dirt. This dirt may consist of combinations of stearic acid, tallow, oils, abrasives, carbon from the buff wheels, and fine metal dust. Such dirt when packed and dried on to the work is difficult to remove. The base metal may be of several kinds, such as brass, steel, britannia metal, nickel silver, and die casting alloys. The plater's job is to clean this work in racks or on wires satisfactory for plating by means of a series of dips and rinses.

Soaps or mineral cleaners are commonly used for removing the bulk of this kind of dirt. In some cases it is possible to rinse the work in water and go directly from a single cleaner of this kind to the silver strikes. But when a high degree of efficiency and quality is demanded, this is usually impossible. In such cases, a caustic dip buffed to prevent staining is used to more thoroughly remove the soap and oil. Electric cleaners either direct or reverse are used for removing fine particles or films which cling tenaciously to the surface. A cyanide dip is often used for removing certain stains, and an acid pickle to dissolve any oxidation and to put the metal in the condition necessary for the plate to adhere. Sometimes these acid pickles are used to bite or etch the surface of the metal. In most cases, this can and should be avoided, since even a slight etching may be apparent after plating.

Definite standards should be set for each dip and plating solution and maintained by routine chemical analysis or other tests.

Rinsing is important in the cleaning process. The intake and overflow of rinse tanks should be arranged so that the rinses will clear with the minimum flow of water. Much carry-over from one dip to another can be prevented by selecting chemicals which will rinse off freely.

On some metals, a thin nickel plate previous to silver plating has a remarkable effect upon the finished surface. Many defects in the base metal may be overcome by this means.

One or two silver strikes are necessary before the work is ready for plating. These strikes are silver-plating solutions of very low silver and high cyanide content. A high current density is used so as to cause a vigorous evolution of gas on the work which is the cathode. Strikes act as a combination electric cleaner and plating solution. It is necessary to control the silver and cyanide content closely; also the current density. Improper striking is one of the most common causes of the plate's peeling.

Silver plating solutions vary widely in composition, but those in commercial use contain either sodium or potassium silver cyanide, sodium or potassium carbonates, and in some cases chlorides. The proportions of these chemicals vary according to the requirements and experience of individual platers. Numerous formulas appear to give good results.

To insure uniformity and high efficiency, certain factors must be kept constant. The silver cyanide and carbonates should be controlled within a predetermined range. For high grade, heavy deposits, the silver and cyanide should vary less than one ounce per gallon. The control of temperature and current density is of equal if not greater importance than the exact composition of the plating solution. This is especially true when carbon bisulphide is used as a brightener. The effect of a change in temperature of one degree can be noticed in the appearance of the plate from solutions containing this chemical. Very remarkable results can be obtained by the use of this agent if conditions are properly controlled. When not controlled, best results are obtained without it. Extremely small quantities of carbon bisulphide will produce the desired effects and it should be added very dilute. One part by volume to twenty thousand seems like an extreme dilution; yet one ounce of this strength added once or twice daily to 300 gallons of potassium cyanide plating solution is sufficient to produce uniform bright deposits even up to three thousandths of an inch thickness. In order to get these results from such small additions, it is neces-

sary that the temperature, current density and composition of the bath be kept constant and that a high current density be used. These additions figure something like one part to 750,000,000. A few million either way doesn't seem to make much difference. In such concentrations, additions can be made without harm while work is being plated. Larger amounts less diluted are commonly used, but at greater risk.

The racking or wiring arrangement has a decided effect upon cleaning and plating processes. By proper racking and anode arrangement, the plate can be distributed over the articles uniformly, or if desired made thicker on places of greatest wear. Of late more attention to the distribution of plate is rightly being demanded of the plater.

Just how much technical control is desirable must of course be determined for each industry individually. As with many things, so with control, quality is of more importance than quantity. It is doubtful if intelligent, well directed control has ever been carried to an unprofitable extreme, and, in spite of the progress that has been made in this work, lack of control still remains one of the greatest wastes in manufacturing industries.

CHAIRMAN GEHLING: Those three papers are now on the floor for discussion.

MR. C. H. PROCTOR: Dr. Sanigar's paper, of course, was very interesting, and his conclusions are very diplomatic, because when he refers to the silver plated spoons, he tells us that apparently there was no difference in the deposits from the potassium or sodium cyanide silver solutions. When the articles were finished, there was no difference. Of course that would agree with what we are doing in this country today. We deposit from potassium cyanide solutions and from sodium cyanide solutions. But I think the amount of sodium cyanide that is used in silver plating is at least ten to one, compared with potassium.

We talk of costs. Of course we have to consider costs in manufacturing today, because that is one of the great, big factors. I don't think Dr. Sanigar mentioned the cost problem at all. When we realize that you can buy three pounds of sodium cyanide for the cost of one pound of potassium cyanide, and the difference in the CN factor would prove that you get the equivalent in three pounds of sodium cyanide to the CN factor of four pounds of potassium cyanide, the cost factor is evident.

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Now we will agree there is no country in the world that is doing

better plating than we are doing in America. We are doing better silver plating than they are doing in any part of the world, and so far as the two factors, sodium cyanide and potassium cyanide are concerned, I frankly can't see any difference when they are used on the same CN basis.

MR. OSCAR SERVIS: I would like to ask Dr. Sanigar what amount of carbonates are permissible in the solution, without any detrimental effects.

DR. SANIGAR: As far as I have been able to make out, you can't give a definite figure for the amount of carbonate which is detrimental. More depends on the ratio of the cyanide to the carbonate. Provided you keep sufficient free cyanide in the solution without overstepping the mark, then the amount of carbonate can't become detrimental.

Of course there is the possibility more so in America than in England that if you are using sodium salts, sodium carbonate may crystallize out. I say there is more possibility here than in England because you have a lower temperature than we do. But I can safely say I have never met anybody in England who has had any trouble with sodium carbonate crystallizing out, and usually you will find that the solutions do not get to a point where that occurs. And as I said before, provided you keep a fairly good ratio between the cyanide and the carbonates, whether it is in exact ratio (and what the exact figure would be, I can't say)—if you keep that in mind you get into no trouble.

MR. SERVIS: What method would you suggest to remove an excess of carbonates in the solution?

DR. SANIGAR: Again I must say for America (I think Mr. Hogaboom will agree with me, if he is here) you freeze it out, because that doesn't cost you anything. But if you don't freeze it out, then I should say add something like barium cyanide. That will give you precipitated barium carbonate. The trouble is there that you have to filter or allow to settle if you can, and that gives you a certain amount of cyanide back in your solution, and you have to take that into account.

Whilst I am on my feet I should like to differ, diplomatically, with Mr. Proctor when he says America is doing the best silver plating. I am from Sheffield and from England. I don't think I need to say any more. We are doing some jolly fine work in Sheffield.

There is just one point on Mr. Wick's paper,—the direct titration

of the carbonate. I know this method is being used; it is practically the same, except it avoids one operation. You precipitate the carbonate with a barium salt. Usually it is barium nitrate. Filter that carbonate off, and of course you have got to wash until it is free from the alkali. Wash with hot water until you don't get any alkaline reaction towards litmus paper, and then you can, as Mr. Wick said, and which is the usual method, dissolve up in a known excess of acid, then back titrate the excess of acid that you have left. But if you are careful, you can do a direct titration, that is, take your filter paper cone containing your carbonate, put it in a beaker or flask, stir it up well, and have it nice and warm, then use an indicator and directly titrate with standard hydrochloric acid. That cuts out one operation and is accurate enough for commercial control.

I should like to support what Mr. Thurber has said about the effect of the base metal. I didn't touch on that. As a matter of fact, I didn't say half of what I wanted to say, but that is very important. The preparatory processes for the plating are important as affecting the structure of the basis metal. That of course affects the deposit, and very often you will find that silver solutions will accentuate irregularities, and bring them out more clearly in the finished product.

MR. M. R. THOMPSON: I would like to ask Dr. Sanigar in the case of the Polarograph curve he showed, in the extreme right hand portion, it went up.—Does he attribute that to the primary deposition of hydrogen or primary deposition of potassium?

DR. SANIGAR: It is potassium. Hydrogen comes out sooner than that, around 1 volt, although I don't have the exact figure. I can give you more details if you like, but undoubtedly the last portion at—2.0 is potassium.

MR. THOMPSON: Can you prove it is primary potassium or secondary hydrogen?—That is, potassium throwing out.

DR. SANIGAR: Well, I think that would take some considerable work and some considerable argument. So I am pretty certain it is potassium, because the hydrogen would come out sooner than that.

MR. HOGABOOM: I would like to ask Dr. Sanigar whether he has found with this meter that he has measured, that either potassium or sodium has been discharged, and if so, what was the discharge potential, and how does that compare with the published discharge potential of those two elements?

DR. SANIGAR: The Polarograph is rather an unusual method

in this sense. It is used in conjunction with a special dropping cathode in that you are always getting a fresh surface of mercury, down a rubber tube, at the tip of which there is a capillary. That capillary goes through a cork and dips into a special shaped conical flask in which you have your solution, and on the bottom of this flask, underneath the solution, there is a layer of mercury which serves as your anode. Now the point about the dropping mercury cathode is that you are always getting a fresh surface of mercury. That is hardly the same, it certainly is not the same, as the silver deposited in an ordinary trade solution, because once you get the first film of silver on your cathode, you are depositing silver on silver. In the Polarograph you are depositing silver all the time on fresh surfaces of mercury, and whilst that gives values which are peculiarly values associated with the Polarograph, there is no doubt that that was the deposition of potassium, because simple salts such as potassium nitrate and chloride have been tested in the apparatus, and have given the deposition points at that figure.

MR. HOGABOOM: How does that compare with the figure that is published? Have you any data?

DR. SANIGAR: I haven't. I think they are pretty close. Most of the values are pretty close, and of course the values are affected by the concentration of the iron in the solution. If you dilute your solution, you shift your potential somewhat.

MR. J. H. HOEFER: I would like to ask Mr. Thurber what the reaction of the trade is to applying nickel before silver plating, eliminating some of the strike solutions?

MR. THURBER: I don't think I understand your question.

MR. HOEFER: I mean as a substitute for some of your silver plating, to use nickel. Suppose you are applying two hours of silver and say you substitute twenty minutes of nickel for a half hour of silver or something like that.

MR. THURBER: I haven't much knowledge of the reaction of the trade to that. I would think in most cases it would be favorable. If the base metal was inferior to zinc, whether it would be favorable to substituting nickel for silver I wouldn't say. In cases where I know of nickel being put on under silver, it is done primarily for the purpose or for the effect it has upon the overcoming of base metal defects and producing a better crystal, more favorable for finishing in the silver plate. It only takes a very thin strike of nickel to accomplish this result. I haven't very much

knowledge in regard to what is being done in putting it on to take the place of silver as a protective covering.

MR. J. H. HOEFER: The reason I asked that question, a plater in Chicago very enthusiastically told me he was saving considerable by substituting nickel for silver, and giving a better job, so I wanted to get the reaction of the trade to that sort of thing.

MR. HOGABOOM: Dr. Sanigar, the reason I asked my previous question was because there was some discussion as to whether, for example, in a nickel solution where there is present a sodium ion, whether it would be discharged at the cathode and combined with some of the elements to form for example sodium hydroxide, and it would have an effect upon the pH of the solution. And I was wondering whether you had found in your work whether the discharge potential in the presence of cyanide and silver of potassium or sodium was different from what the discharge potential as recorded might be; whether the influence of the electrolyte was marked upon the discharge potential of those two elements.

DR. SANIGAR: No, I haven't any comparative figures, but I should say not. Sodium, potassium and lithium come out at extremely negative voltages, and in an ordinary solution you get most of your other metals first, and you would have to so deplete the bath of metal ions before you get potassium or sodium deposited that a plater would get mad and throw the bath overboard long before he came to that.

MR. G. GERAPOSTALON: I would like to ask Dr. Sanigar if he noticed any change in the rate of deposition of silver in different concentrations of cyanide in the solution.

DR. SANIGAR: I did not study the effect directly. I studied the effect somewhat by dilution of solution, and of course that did affect the deposition potential of the silver. Just in the same way as a simple potassium nitrate solution, for example, gives you deposition of potassium of one point,—dilute that ten times and you get a certain shift.

MR. GERAPOSTALON: I mean in the effect of the rate of deposition, if it is a certain time more or less with the same current density; all other conditions the same, but just increasing the free cyanide in the solution, whether you get more or less silver deposit.

DR. SANIGAR: I haven't done anything along that line.

MR. HOGABOOM: I would like to ask Dr. Sanigar whether he has found that if the free cyanide content is not kept in the same

relation to the carbonate content as he recommends, as he suggests, rather, whether that wouldn't affect the character of the deposit.

DR. SANIGAR: I certainly think it would.

MR. HOGABOOM: Then may I ask the relation of the carbonate and cyanide content in the two solutions in which you did your work for measuring to determine the hardness of the deposit? Did you determine that?

DR. SANIGAR: Well, you see it comes back to this, really,—very little research has been done on silver plating. Now I explain that by saying that silver is one of the easiest metals to deposit. You get a solution containing the double cyanide with or without carbonate and over very wide ranges of composition and electrical conditions and temperature and so on, you can get a good deposit of silver. Well, now, in studying the hardness, the effect on the hardness of various factors, it was necessary to keep as many other factors constant as possible. So I kept the silver concentration and free cyanide constant. In that way I was able, as I added more carbonate, to determine its effect.

MR. HOGABOOM: What I referred to mostly was the two sample lots of spoons you plated under commercial conditions. What was the relation in those commercial conditions. What was the relation in those commercial conditions of the cyanide to the carbonates? If you have an empirical method of testing the hardness of the deposit, and then do not know this relation and that relation of the carbonates, of cyanide, which have marked relation to structure of the deposit, how can you evaluate anything?

DR. SANIGAR: In carrying on the tests, I tried to get out of the test as much as possible and have the commercial platers do the work, the finishing and everything; and it was impossible for me to interfere with the analysis of the solution. I gave those analyses in the paper, which I mentioned, and there are slight differences, and of course that was recognized. But what I was out to prove was not so much to be able to say that sodium cyanide equals potassium cyanide, but to be able to say that potassium cyanide shows no marked advantage, and I think I got that point. Of course, there is always this: The extra conductivity of potassium cyanide gives us a certain advantage, if you are using high current densities, and there is the extra solubility of the potassium salts. That again is an added advantage. But just as in, say, nickel plating, we heard yesterday morning that we were advised to use

one type of solution for one job, and one anode for that solution; so it is impossible to say that for all conditions the two cyanides are equal. It is quite conceivable that under certain conditions one might be better than the other. But that would need further research work to explain why that should be so. I think people have very strong opinions still as to which they prefer.

MR. HULL: I would like to ask Dr. Sanigar as to the effect of crystal structure and crystal size, whether he gets a matted finish or very fine finish,—a variation of that with the cyanide content. That is, you start out with a maximum hardness, with a very low cyanide content, and then decreased and then again increased with a very high cyanide content. Now was that initial extremely hard deposit a very matted, or a very bright finish?

DR. SANIGAR: Well, as far as I remember, the change of the deposit was something like this: I started out with no free cyanide, and found difficulty in getting the current through the solution. I would get an initial current, which would rapidly drop off. The deposits were matted and liable to be all colors of the rainbow, which would wash off. Then with about 25% excess free cyanide in the bath, it began to work respectably, giving a somewhat matted deposit,—it was a semi-mat deposit. There was some carbonate in the solution, and that of course affected the structure of the deposit, too. And the deposit remained semi-mat until I got about 200% excess cyanide, and then it began to go bright, and from that part onwards, it increased in brightness until about 400% excess cyanide, when there was what I referred to as a zincy bluish smooth deposit, and that persisted up to 600% excess cyanide. There is no doubt whatever that the potassium, carbonate, and cyanide do have an effect on the crystal structure, and as brought out by Mr. Thurber, the amount of carbon bisulphide in the solution is very, very little but that has a very marked effect on the crystal structure, and I am perfectly certain that that is due to the same cause as the effect of carbonates and cyanide, that is, you have the silver crystals growing in a different environment.

MR. HULLS: You get a deposit of the same hardness with either a very high cyanide or a very low cyanide, but in the case then with the low cyanide, the deposit is matted, and in the case of the high cyanide it is very fine and bright; is that the idea?

DR. SANIGAR: That is roughly the idea over that part of the

curve where the hardness ascends. At the beginning it was hard, then it came down and went somewhat harder.

MR. JOHN FEELEY: Dr. Sanigar, in your tests for the hardness for silver, have you compared the effects of the different methods of buffing, or burnishing? In England, for instance, spoons are burnished by hand with lime, and very little of that is used in this country. Do you find that the bobbing of the spoon prior to coloring with lime or cutting down with hard and soft rouge, with the girls over there burnishing with the wrist stroke against the machine stroke here, makes any difference?

Mr. Proctor said he thought we did the best silver plating in the world here in America. So do I. I was over in Sheffield a year or so ago, and although they are depositing silver, and have been the early ones, they do not seem to have progressed along the lines of stability. For instance, they claim over there equal distribution of silver. We claim over here we don't want it equally distributed; we want it unevenly distributed, distributing the silver on the wearing parts. That is why we think here we do a better job.

DR. SANIGAR: I have no figures on the comparative methods of burnishing, although I have been interested in it for a long time, and it is one of the points I should like sometime to be able to settle,—the methods of finishing and their effect on the hardness. From purely theoretical reasoning, I should imagine any of the finishing processes that do cold work, or relatively cold work on the silver, would harden it, and I should imagine that burnishing would make it harder. Whether any difference of hardness would be sufficient to give the silver in one instance better wearing quality, I am not prepared to say.

And with respect to our diplomatic differences about the relative merits of the silvers, people in England now are doing what is being done over here, that is, getting a patch on the back of the bowl for wearing purposes. Mr. Mesle read a paper sometime ago before the Society on the distribution of silver and the various methods of racking. That is another point upon which research should be done. And I want to take just this opportunity of emphasizing that although silver seems to be such a simple metal to deposit, once you start getting into it you find there are difficulties, and although you might not have an obvious difficulty such as peeling with nickel or refusal to get a deposit into a corner, as with chromium plating, you still have problems, and I am very glad that at least a portion of the research on silver plating

is being tackled at the Bureau of Standards, and I hope other people, as they have time and opportunity, will do the same sort of thing, and in a few years we shall have to have a whole lot of research on silver plating and understand much more about it.

INTRODUCTION OF IRON INTO ALKALINE CLEANING AND PLATING SOLUTIONS

By E. J. Liscomb

Read at the Washington, D. C. Convention, 1930

From time to time a request for credit comes through the mail for a steel plating tank that has failed, i.e., showed signs of corrosion or actually perforated. Many tanks have been replaced with new ones only to have a repeat request for another. There have been so many steel tanks that have failed that it has become a hardship for the manufacturers. As it was realized that all of the tanks could not be defective, an investigation was started in an endeavor to find out the reason for the numerous failures. One has not far to go to find this reason if he happens to be a close observer.

Steel tanks have been used for generations as containers for cleaning solutions. We used weak solutions and low temperatures and expended much arm power at the handle of a scrub brush. But all of this has been changed, and now in this age of production we must resort to less laborious methods for cleaning the work to be plated. Therefore, we install electro-cleaners and high current densities and do the work in a fraction of the time consumed by the old method of hand scrubbing.

Now, electric cleaning is a very proper method when it is performed in an intelligent manner, but unfortunately the process has its limitations. In the first place, the tank should never be made the anode of the circuit, because eventually corrosion is sure to follow. Caustic soda, soda ash, or sodium cyanide, when used as a cleaner, will cause no trouble so long as there is no salt such as sodium sulphate, trisodium phosphate, sodium chloride, or ammonium chloride present; even the sulphate and phosphate may be neglected provided there is enough caustic soda present. However, if the caustic soda has become destroyed by age, the sodium sulphate and phosphate, if present, will commence to corrode the steel tank. Chlorides, no matter what kind, will attack the steel

even in the presence of much free cyanide and sodium hydroxide.

If the steel tank is the anode of the electric cleaner, the plater should know if his cleaner solution is attacking his steel tank. A simple test will apprise him of the fact. All that is necessary to do is to take a drinking glass, fill up the glass with the cleaning solution, (preferably filtered) then with two pieces of wire connected to the bus bars of the dynamo, place a steel nail on the other ends of the wires and dip the ends of the nails into the cleaner solution. Let the electric current flow through the solution and watch the anode nail. If the solution contains chemicals that will cause corrosion, a heavy scum will form on the anode in a very few minutes.

Trouble often occurs when you have a lot of work that must be pickled. This is done in sulphuric or muriatic acid, after which you rinse, dry, polish, and go to the cleaner. The iron or steel has iron sulphate or chloride in the pores which the cleaner neutralizes. The iron in the salt is precipitated and sodium chloride or sulphate is formed. Each day increases the amount until at last the alkali is weakened and the sodium chloride and sodium sulphate get into action, and eventually, if used as an anode, the steel tank goes to the junk pile.

Again, we find that some operators will take the work out of the pickle and neutralize the acid in the cleaner without a previous rinse. Cleaning solutions have been found that actually showed acid reaction with blue litmus paper. The remedy is obvious, and it is within your power to correct the evil.

Where work must be pickled be sure to rinse the acid away by the use of several rinse waters, neutralize the remaining acid in a strong alkali other than the electric cleaner, and again rinse well, and lastly take the positive connection off of the cleaner tank and install anode rods insulated from the tank and fitted with large steel anodes. This last suggestion does not cure the evil; it only delays the day when the tank is junked unless care is taken to exclude the acid mentioned.

Acids are not the only offenders, for where only one rinse tank has been installed, nickel sulphate gets into the cleaner and cyanide plating solutions in steel tanks by being carried from the foul rinse water. Nickel solutions also contain chlorides as well as sulphates, and these, too, should be rinsed away.

Avoid the use of low percentage sodium cyanide, as this often

contains as much as 20% to 25% sodium chloride. This sodium cyanide is satisfactory for heat treatment of steel but not for plating.

Just one more thought—perhaps you use what is termed the reverse current in the cleaner, and you think that because the work comes out of the cleaner with a dirty color you are plating out the dirt. Well you are not. You are simply undoing what the polisher has done because of the fact that the cleaner is low in caustic and high in sulphates and chlorides of soda or ammonia, which means that you actually etch the work you are about to plate, and if the "dirt which you plated out" is not removed by an acid, then the plating may peel, blister, or pit.

In the old days electroplating was something of a mystery even to the best informed. All formulae said to dissolve so much of such and such chemicals and if the solution does not work, then add so and so. Then the more thoughtful ones began to investigate to try to find out the why. Finally there came methods of analysis for plating solutions. These data were based on the published methods of analysis of solutions which contained only pure chemicals—at least they did when new. However, a plating solution that has been used for a long time may have gathered some other metals such as zinc and copper, cadmium in nickel solutions, iron which may appear as ferrocyanide in alkali baths, or salts of the strong acids as chlorides and sulphates. Some of these impurities exert a powerful influence even in microscopic quantities. With this thought in mind some experiments have been carried on, not necessarily to a final conclusion, but to a point that indicates that we are not going into the chemical research as far as we should, which is an argument in favor of more funds for the Research Committee. The results of these experiments, as well as some observations, are here set down in the hope that further work may be done by others more capable.

Some years ago our attention was called to a large cyanide brass plating solution which was working badly. An effort was made to analyze the solution for metals, carbonates, free cyanide, etc. As the analysis proceeded it became evident that there was a metal present other than copper and zinc. This metal proved to be iron. Since then solutions have come to hand from time to time that contained iron. However, little attention was paid to its presence; no attempt was made to ascertain in what form the iron was held or what effect it may have had on the deposit of copper, brass,

or cadmium; or what, if any, action it had upon the anode. Very recently three cyanide solutions have come to hand, one a cadmium. Here it was noted that the steel supports of the cadmium anodes were gradually disintegrated to such an extent that they fell apart, and at low temperature (60° F. to 70° F.) small, transparent, sand-like crystals, which gave no reaction for either sulphates or carbonates, formed on the steel. Eventually they fell off and accumulated on the bottom of the tank. After these crystals were gathered and lay in the air for several days they lost their water of crystallization and a white powder resulted which was still soluble in water. When hydrochloric acid was added a green solution resulted. It was also noted that the tank was corroded at the ends to such an extent that it had to be replaced by a new tank.

Two copper solutions came to hand that contained a small amount of free cyanide—a little metallic copper. The solutions had a peculiar color. The anodes were coated over with a reddish-brown, fur-like coating, which much resembled copper ferrocyanide.

Experiments have been carried on with sodium cyanide solutions to which iron salts have been purposely added in the presence of varying amounts of free sodium cyanide. Both ferrous sulphate and ferric chlorides were tried. The "ous" salt seemed to be the most completely dissolved in cyanide, especially when there was sodium hydrate present. All of the iron salts, either "ous" or "ic" are not completely soluble in cyanide sodium. No matter how strong or how hot the solution is there still remains undissolved iron precipitate in the cyanide solution with either "ic" or "ous" iron in solution. When all of the iron salts have been dissolved that will dissolve, there is still free cyanide present. To these iron solutions was added enough copper cyanide so that no free sodium cyanide remained. Then, when a current of 6 to 7 amperes per square foot was passed, a good deposit formed on the cathode, while the copper anode became covered with a thick coating of a mixed, blue-green solid and a reddish-brown scum. Sodium cyanide was added in quantities of ¼ ounces per gallon until at about ½ ounces per gallon only the reddish-brown scum was apparent on the anode. At approximately ¾ ounces per gallon of sodium cyanide the anodes did not coat heavily at 6 to 7 amperes per square foot. To find what would be the effect of a greater current density with the same amount of free sodium cyanide, the current was increased to approximately 15 amperes per

square foot, and it was found that in 15 minutes there formed on the anode a thick, heavy, reddish-brown coating, which corresponded to the color of copper ferrocyanide.

From this we gather that for a cold copper cyanide solution where the sodium cyanide content must be kept down (in the interest of high cathode efficiency) the presence of iron will be detrimental to good anode corrosion due to the ferrocyanide formed. In warm solutions, where a much larger free sodium cyanide content can be maintained and we can still have a good cathode efficiency as well as a higher current density, it is predicted that there would still be some difficulty unless care were taken to offset the ferrocyanide with the free cyanide, temperature, and current density.

Just how the iron gets into the solution in the first place is a problem. We know from experience that in some solutions, (electric cleaning) when the work is being cleaned electrically on the anode or positive pole, the steel is attacked, showing the characteristic color changes peculiar to ferrous hydroxide; viz., the first color noticed is white. This is soon followed by a greenish color. Later this, when exposed to water or air, becomes the color of iron rust (ferric hydroxide). Since this red color does not seem to go into sodium cyanide, at least not completely, it is presumed that when the ferrous hydroxide is white or in the early stage of the green color, and it is on the surface of the work, going into the warm cyanide plating solution, it is probably soluble in sodium cyanide, at least to some extent, and forms sodium ferrocyanide. Then if this is so, it follows that if a piece of steel or iron is pickled in an acid and not completely rinsed and neutralized the iron salts produced do undergo a chemical change to form hydrates, (ous) which seemingly are soluble in cyanide and hydrate and do form sodium ferrocyanide.

Again, even if the iron salts from the pickle solution were not converted into ferrocyanide, there would at least be a chemical change between the acid radical of the pickle acids and the alkali of the cleaner, and there would form as a part of the reaction a sodium sulphate or sodium chloride, depending upon the acids used in the pickle, (sulphate distinct from chloride). With these chemicals in the plating solutions in contact with the iron heating coils and the steel tank, which may get into the path of the electric current, i.e., become cathode near the back of the copper anode and anode at the end or bottom of the tank near the true

cathode proper, at that portion of the tank that became the anode, electro-chemical action is set up to such an extent that the steel tank becomes corroded and even perforated, exactly as described above in connection with electric cleaners. If, then, the white or green (ous) iron hydrate at the instant of formation is dissolved in the sodium cyanide and hydroxide of the bath, the final result will be the same; namely, the formation of sodium sulphate or sodium chloride and possibly sodium ferrocyanide.

Therefore, the obvious solution of the problem is to prevent mineral acids or salts of strong mineral acid from getting into the alkali plating solution even in small quantities, because even after they have attacked the tank and a portion at least of the dissolved iron goes into solution or is precipitated as hydrate, the salt of the acid is regenerated and is free to act again, etc., ad lib. If, however, such salts are present, and they are frequently added to the solutions, intentionally in the form of sodium sulphite, bisulphite, hyposulphite, sodium sulphate ammonium chloride etc. some provision should be made to prevent the electric current from coming into contact with the steel tank. Therefore use rubber-lined steel tanks which will keep down the effect of sodium sulphate or chloride on the steel tank and leave only the anodes in the solution open to the action of the chloride or sodium ferrocyanide, if present.

As it was realized that all mineral acid salts may not act the same, some tests were run which would determine which acids were the most detrimental. Then solutions of sodium cyanide with the additions were prepared, each in a separate beaker. The electrodes were of steel and the electrodes of the several cells were electrically connected in series. A current of suitable strength was passed for a period of one hour. The presence of rochelle salts resulted in no corrosion of the steel anode. However, in the presence of sodium chloride or ammonium chloride, there was a very heavy corrosion of the steel anode; yet the action of the sodium chloride was different than that of the ammonium chloride. With ammonium chloride there the iron seemed to go into solution momentarily. As this metal-charged solution came in contact with the chemicals, a precipitate formed around the drops. The color of this precipitate, at first whitish, later turned to a bluish-green color and eventually became very dark brown in spots (ferric hydroxide.) As the action continued a very fine example of that chemical phenomenon known as "chemical garden," formed. As

the solution filters through this precipitate or membrane to dissolve more iron at the anode, the membrane will break and the iron-bearing solution will burst forth only to be confined by a new membrane at the point of the rupture. Some of the branches were as fine as a hair and extended upward for at least two inches.

In that solution where sodium chloride was used, the action on the anode was as great as where the ammonium chloride was used, but there was no chemical garden formation.

In a silver solution made from silver chloride and cyanide, to which was added some ammonium chloride, there was still another type of result at the anode. (And from this it is gathered that there is really more in this subject than appears on the face. Notwithstanding the fact that such solutions have been used for years without complaint, it does not follow that there was no reason for complaint. Probably the thought was that these conditoins just had to be, as was the case with the yellow sludge in nickel solutions where 90% nickel anodes were used. "It was just there, that's all.") Both ammonium chloride and sodium chloride were present. The latter resulted from the reaction when silver chloride was dissolved in sodium cyanide. There formed at the anode a yellowish, ochre-like precipitate, which slipped off the anode and fell to the bottom of the beaker. Later, when this solution was taken out and stirred, it was noticed that the particles were very small (colloidal) and that they did not settle rapidly. The solution was then boiled with more sodium cyanide solution, after which it was cooled and placed back in the line, and the action of a fresh steel anode was noted. On this second run the anode scale was exactly the same as in a bath where sodium chloride alone was used. Why the anode slime should change from yellow before boiling the solution to brown after boiling it is not known, unless the boiling drove off the ammonia to form additional sodium chloride.

It begins to look as if there are certain plating solutions in which ammonium chloride may not be used, while in other solutions it may be useful; as for instance in nickel solutions where the ammonia complex seems to cause an action on the anode whereby the anode efficiency is greater than the cathode efficiency. At least the metal content of the solution does increase. However, in an acid copper solution ammonium chloride will cause a yellow copper chloride to form on the anode which is insoluble in the acid copper solution. This may be gathered and washed and dissolved in nitric acid, and with silver nitrate test solution it will react for chlorine.

Again, with the presence of sodium chloride in certain types of nickel solutions where high current densities are used, it has been noticed that the sludge is rich in nickel hydrate which forms and settles at the bottom of the tank.

Later Experiments:

It was noticed that in a solution known to contain ferrocyanide, sal ammoniac, and sodium cyanide, and in a silver solution which contained both sal ammoniac, sodium chloride, and sodium cyanide, the iron anode scum was of a dark blue color upon being examined in a strong light when dry, (see above). When it was treated with ammonium chloride a portion of it went into solution, (Prussian blue).

With ammonium chloride and cyanide and an electric current a yellow scum formed on the steel anode (see remarks above on silver). Hot caustic soda dissolved a portion of this precipitate. The solution then gave a green color with hydrochloric acid, (iron) when a copper anode was put into action in this solution it gradually became covered with a red copper ferrocyanide, indicating that the iron that had been removed from the steel anode due to the presence of the ammonium chloride had been dissolved in the cyanide; or else this was done by some reaction that did cause the formation of sodium ferrocyanide. This, of course, set free the chlorine, which was then free to attack the steel tank or other iron that got in the path of the electric current.

In the solutions of ferrocyanide, sodium cyanide, and sodium chloride, the anode scum seemed to be wholly red iron hydroxide.

In a solution of sodium cyanide and sal ammoniac, the copper anode gives off a green color which is expelled by more cyanide, but when the sodium cyanide becomes saturated the color of the solution and the slime from the anode indicate the ammonia copper complex and the presence of ferrocyanide, as the copper anode takes on a red color.

When only sodium cyanide is run with a steel anode there is no visible action on the steel.

Summary

Work which is pickled in hydrochloric acid, or other acid, for that matter, should be well neutralized and rinsed several times in clean water before going to a plating solution.

Cleaning and alkali plating solutions should be from all chlorides, or the tanks should be rubber lined.

Unlined steel tanks should not be used as the positive or anode in any cleaning or plating solution.

All electric cleaning and alkali plating solutions should be tested with steel electrodes to see if the solution attacks the steel tank under the influence of the electric current.

Seemingly sodium ferrocyanide does not interfere with anode corrosion in alkali copper solutions except where the free cyanide content is low and the current density is high.

Sodium ferrocyanide in the presence of sodium cyanide does not affect the steel anode seriously.

Rochelle salts added to cyanide solution did not attack steel, but 76% sodium cyanide, i.e., chloride mixture, should not be used for plating.

Ammonium chloride should not be used in acid copper solutions.

Steel tanks should be rubber lined to prevent a metal deposit on the tank back of the anode, i.e., false cathode. At some other point as the end or bottom of the tank, e.e., false anode, if chlorides are present in the solution the tank may be expected to be corroded or even perforated due to this series connection. Moral: Line steel tanks.

The object of this paper is not to tell you something but rather to start something. Thanks are due to Dr. W. Blum and also to Mr. Harold Faint for helpful hints.

(Applause)

CHAIRMAN SMITH: You have heard the reading of this paper, gentlemen. Is there any discussion?

DR. WM. BLUM: I would just like to call attention to one point, and that is that in the analysis and study of all cyanide plating solutions, we have got to take into account the presence of iron, probably as Mr. Liscomb said, in the form of ferrocyanide, so that for example in the paper Mr. Wick will present on the analysis of silver plating solutions, you have to take account in your analysis of the fact there may be ferrocyanide. We saw last week an analysis of a silver solution, a strike, a very weak silver solution, which showed an ounce and a half of silver cyanide per Imperial gallon, and over five ounces of ferrocyanide. That was hardly a silver strike; it was more an iron strike.

MR. HARVEY GAUSING: Would it be possible to enter iron into a cyanide copper solution by using an iron hook for your anode? The iron hook being submerged in the copper anode.

MR. LISCOMB: If there was sal ammoniac in the solution, or common salt, you might expect that that would happen.

MR. GAUSING: Just sodium cyanide, copper cyanide, and hyposulphide.

MR. LISCOMB: That is a very bad actor, hyposulphide, in the presence of free cyanide.

MR. R. W. MITCHELL: Iron as silicide can be chemically corroded by highly alkaline solutions such as a solution of caustic soda, through strict chemical action. This iron which will go in solution then is in the form of hydroxide, suspension of finely divided solid particles; as most of you probably know, finely divided solid particles in a solution which is under potential, will migrate either way, to the anode or cathode, so that the phenomenon known as electrophoresis takes place. Now most of the metal hydroxides in an alkaline solution will absorb on the colloidal particles of dissolved iron of negative charge, making the suspended particles bear a negative charge which will pull them to the anode and they will be plated on the anode. That is quite common in solutions which contain iron hydroxides which may have been brought in through some one of the means Mr. Liscomb has mentioned, or a very common means, of course, would be incompletely rinsed parts which have been in a pickle going into a solution; a little ferrous hydroxide which would be slowly oxidized to ferric hydroxide, and under potential those particles appear on the anode surface. I have seen low carbon steel taken from a solution with such a heavy film of brown iron hydroxide on there you would think it had been actively rusted. This, I think, was solely due to the fact of these suspended particles migrating to the electrode and being discharged there.

S. P. GARTLAND: I would like to ask Mr. Liscomb in regard to the phosphate, using a sodium phosphate; that it has a detrimental effect on the tank if you use steel anodes.

MR. LISCOMB: Tri-sodium phosphate by itself would corrode the steel electrode. That is why we suggest that the tank be not connected as the anode.

MR. LAWRENCE: It is practically impossible to buy chemically pure caustic soda. The average commercial caustic soda you buy, when bought in solid quantities, packed in steel drums, it is practically impossible to obtain it free from iron. In some instances, perhaps, where it is packed in steel drums, you find as high as 6% in there. I mention this on account of Mr. Mitchell's mentioning

the ferrous or ferric hydroxide being present in the solution will deposit on the anode. I think it would be impossible to draw the lines so fine, because it is impossible to obtain caustic soda free from iron particles or iron salts.

MR. LISCOMB: Well, the thought in this paper is not the iron, particularly, but the iron is there as a result of other impurities, as for instance, muriatic acid, sulphuric acid, and chloride, and such as that. The iron itself does not do any real harm, excepting perhaps in the copper solution. But when the iron is in the solution, or the acid finally gets in the solution, the iron may be precipitated as a hydroxide, and sodium sulphate or chloride is formed. Then that molecule under the influence of the current may be split up and attack the steel tank, or the steel anode. And the moment that it does that, the two solutions then become mixed and the iron is precipitated and regenerates the sodium chloride and it is free to go to work all over again on the steel electrode.

MR. OSCAR SERVIS: Would it be possible to use a buffer salt or some colloid to prevent this corrosion of iron?

MR. LISCOMB: That is one of the places where your Research Fund is going to help you.

MR. HENRY J. JAMESON: How much iron may a copper cyanide bath contain before the throwing power of the solution is cut down?

MR. LISCOMB: I don't know that it will affect the throwing power. I haven't gone into it to that extent.

MR. JAMESON: Are you advocating that the steel tanks ought not be connected as the anode?

MR. LISCOMB: They should not be used as a positive pole, and they should be lined if it is known that the solutions contain those ingredients that would corrode the tank.

MR. RAYMOND LOPEZ: You also agree that steel tanks should not be used for copper cyanide solutions?

MR. LISCOMB: Not necessarily. If those impurities do get into your solution, you surely will get it.

MR. WHARTON: May I ask how would a hot solution, a hot cyanide copper solution, be affected by the lining, or how would the lining be affected by the hot solution?

MR. LISCOMB: What kind of lining?

MR. WHARTON: Well, what kind of lining could you use so it wouldn't affect it?

MR. LISCOMB: If I was going to build a copper solution tomor-

row, I would use a steel tank, but would see that the electrodes were thoroughly insulated from it, and the anodes would be far enough away so the current would just about as lief go to the cathode as to the tank. And then I would see that the solution did not contain any ammonia, sal ammoniac, or chloride.

MR. G. SODERBERG: I just want to ask, isn't there any difference between different acid radicals? For example, if you compare the chloride with a sulphate, a sulphate with phosphate and so forth, in attacking the steel.

MR. LISCOMB: In the experiments which were carried on,—now you may try experiments and have entirely different results —but in the experiments as carried on, when free cyanide was present, or caustic soda, sulphates did not interfere; chlorides always did.

MR. K. PITSCHNER: Is there any good method of eliminating the copper ferrocyanide after it is in the bath? Is there any way of getting it out?

MR. LISCOMB: Again, I must plead ignorance. I don't know of any.

MR. R. W. MITCHELL: There is one domestic producer of caustic soda which is practically iron free; almost all the other grades contain dissolved iron in the concentrated stage; in the caustic soda it is probably present as sodium ferrate, and when that is dissolved it forms iron hydroxide.

There is one domestic producer that makes it by a special process in which they don't evaporate in iron pots as is commonly done in producing caustic soda,—where they will guarantee no iron is present in the caustic. This material has a large sale in the paper trade, where the color of the paper would be affected by the least trace of iron.

Another point is, in speaking of chlorides being highly corrosive of the anode, and bringing iron in the solution, I think that is probably largely due to the fact that that chlorine ion is discharged on the anode in an alkaline solution under the exact condition where you will produce sodium hypochloride, which is a very corrosive material, has high oxidizing power, and is sufficient to bring the iron into solution probably through chemical action aside from any electro-chemical effect.

MR. HARVEY GAUSING: Sometimes in cyanide copper solutions, the steam coil develops a leak. You will find it at the joints, at the thread, usually in an elbow or a thread, and it looks as if the

thread is being eaten away. Is it the iron or the chloride that eats up the coil, or is it the electric current causing that?

MR. LISCOMB: Well, the iron wouldn't cause it. There would have to be something there that would attack it.

MR. GAUSING: Would it be the chloride in the solution, or would it be the current?

MR. LISCOMB: It would be the result of the action of both of them.

A SILVER-WHITE ALLOY PLATE

By Colin G. Fink and Kihough H. Lah

Read at the Washington, D. C. Convention, 1930

Dr. Colin G. Fink, under whom I have been working, asked that I present this paper. I will not take much of your time. I am not here to present any new theory to interpret our results but I wish simply to present the method we used to arrive at the proper composition for a silver white Co-Ni alloy plate.

Introduction:

The aim of our research was to codeposit a Cobalt-Nickel alloy, which would be practically as white as silver. In earlier researches on cobalt-nickel *cast* alloys, Dr. Fink had found that, if they are combined in right proportion, the yellow color of nickel and blue color of cobalt make silver white alloy. Many people are educated to like a silver white plate.

At the present time, cobalt is expensive, but there is every reason to believe that cobalt will become much cheaper before long. The world production of cobalt has increased five times what it was nine years ago. The greater amount is coming from Africa and Australia and it promises to be greater each year.

Arrangement of Experiment:

The cells we used for this experiment were of glass of approximately the following internal dimensions: 8.2 by 8.2 by 12.3 cm. We used double anodes, one at each side of the cathode, 3 cm apart.

Nickel anodes were of cast nickel, 7.7 cm wide, ½ cm thick, and 12.8 cm long; 8.5 cm of which was submerged in the solution. The effective area was 66.5 sq. cm. They were furnished by Hanson Van Winkle Company.

Cobalt anodes were made from cobalt powder (Eimer and Amend, c. p.) pressed in a steel mold at about 900 lbs sq. in. and

sintered in an electric hydrogen furnace at 1300° C. The sintered cobalt bars were cooled in hydrogen gas, so as to prevent the formation of an oxide film on the surface of the bars. The bars were 1.1 cm wide, ½ cm thick, and 9.1 cm long; 6.8 cm of which was submerged in the solution. The effective area was 7.5 sq. cm (1.16 sq. in.). The cobalt anodes were placed just before the nickel anodes.

Cathode was of brass, the total area of both sides being 38.1 sq. cm (5.9 sq. in.). The cathode was lowered into the solution to such a depth as to be just covered by the solution. I was very fortunate in that these anodes behaved very nicely. If the anodes dissolve with too great readiness, the bath will become alkaline; conversely, if the solution of the anodes does not take place with sufficient readiness, the bath will become acid and depleted in metals. But the pH value of our cells did not vary beyond 4 to 5 before and after the electrolysis when I used a solution from 1 to 2 normal. The solubility of cobalt is greater than that of nickel and it is distinctly in its favor for practical plating purposes.

Bath Composition:

Starting out with a standard nickel plating bath and the Kalmus cobalt bath and then combining the two in various proportions, we found the following formula to give the whitest plates:

$NiSO_4.6\ H_2O$	130 to 260 gm/L	(16 to 32 oz/gal)
$CoSO_4.7\ H_2O$	1.4 to 5.6 gm/1	(.17 to .67 oz/gal)
NaCl	10 gm/1	(1.2 oz/gal)
Boric acid	20 to 30 gm/1	(2.4 to 3.7 oz/gal)

Temperature, about 50°C. (122°F)
Current density, 1 to 2 amp/sq. dm (9.3 to 18.6 amp/sq. ft.)
The pH; 4 to 5
The solution agitated

Analysis of Plates:

The whitest plates analyzed were 55% to 77% of Nickel and 25% to 45% cobalt.

Hardness Test:

Plates	*Microhardness (Bierbaum Unit)*
75 Ni- 25 Co Alloy	250
66 Ni- 34 Co "	250
100 Co	250
100 Ni	86.5
Spring brass (60:40)	77
Hard rolled copper	43.5
Lead	4.9

Corrosion Test:

TABLE

Plates	*Loss, Mg/sq. in.*
100 Ni	1.70
85 Ni- 16 Co	1.52
75 Ni- 25 Co	1.35
64 Ni- 36 Co	.87
52 Ni- 48 Co	.51
42 Ni- 58 Co	1.17
34 Ni- 66 Co	1.65
100 Co	2.00

As the above table shows, the resistance to corrosion increases as the percentage of cobalt increases and reaches a maximum resistance at about 50% cobalt, after that the alloy is less resistant with further increase in cobalt content. (Applause)

MR. C. H. PROCTOR: This is an interesting paper, because I don't believe that we fully realize the value of the addition of cobalt in nickel solutions. I think that there are quite a number of gentlemen here that when we had the Newark Convention, visited the Newark Nickel Plating Company, and Mr. Bergfels explained to them that he got a whiter and harder nickel because he used cobalt in the solutions. Mr. Bergfels had been buying cobalt salts from us for many years.

During the Montreal Convention, I think I brought up the subject of the addition of cobalt in nickel solutions. I gave out a solution at that time. I think it was based upon water one gallon, nickel sulphate thirty-two ounces, cobalt chloride four ounces, and magnesium sulphate twelve ounces. I think I mentioned a normal pH of about 5.2 or 5.4; something along that line. I plated some steel parts. The idea at that time was to determine the hardness of we might say a duo deposit. And so I plated steel parts with less than one ten thousandth of an inch indirectly upon the steel. I still have those plates down in my cellar, and they have never rusted. It shows that there is some influence of cobalt upon nickel that might be a great advantage to the commercial fabricating industry, as well as the electro-plating industry, and I think it is worth while going into.

MR. PHILIP SIVVERING: I think Mr. Proctor has made a statement there that is not intentionally wrong, but he said the nickel being hard; he does prefer it soft and malleable. He can take that nickel and bend it all up. If it was hard, he wouldn't be able to do it. It was the malleability he was after.

MR. PROCTOR: Well, we had the hardness too, and we bent up plates and hammered them, took a hammer and peened through the steel. Of course, we might have ductility; it was malleable.

MR. F. HAUSHALTER: I would like to ask Mr. Proctor would he advocate that solution in case he used it in nickel plating before cadmium plating.

MR. PROCTOR: Well, frankly, we have not done a great deal of work on that solution since I first was interested in it, but I know in Detroit recently they have been doing considerable experimental work with the addition of cobalt to their solutions. Of course we know that by purchases that have been made.

MR. HAUSHALTER: I meant to say before chromium plating.

MR. PROCTOR: That gave a wonderful solution. Of course, you have your hydrogen factor to control in that solution, and so far as its malleability and ductility is concerned, as I said before I took a peening hammer and peened right through the nickel into a block of wood, showing the value of that deposit. Of course we sometimes speak about nickel deposits. If you get a good nickel deposit under your chromium, of course it won't peel off. The point is to put your nickel on right and the chromium will stay on afterwards.

MR. HARVEY GAUSING: Mr. Proctor answered part of my question partly, but he said it makes a whiter or brighter deposit of nickel,—that is, Mr. Lah did. What effect would that have in chromium plating? Would that bring up a different color, or the same color in chromium as we have now,—chromium plating on top of nickel.

MR. LAH: I haven't thought of chromium; our idea has been to make the nickel whiter. That might have some effect.

MR. HOGABOOM: At the time that Kalmus did his work on cobalt, there was considerable work done on cobalt nickel deposits. Mr. Barrows, of Toronto, if he is in the room, can tell us of some experiments he carried on at that time. Mr. Haddow, who was then with the August Goertz Company, plated a large number of samples of cobalt and nickel, back in 1921-1922, and I still have a large number of those samples at my home.

The question of cobalt in nickel has been thoroughly brought out and thoroughly discussed by Mr. Barrows and by the work of Kalmus, and it has been known it does give a beautiful white deposit. As far as changing the characteristics, the physical characteristics of the deposit, I am doubtful.

MR. J. H. HOEFER: Is it possible to operate this cobalt-nickel bath without cobalt anodes?

MR. LAH: Of course, there is so little a percentage, about 1% of cobalt to the nickel, gives about 50% of the plate, so we thought of course we don't have to have an anode; we could supply it with the solution quite easily. I haven't done that, but that is what we believe, that we don't have to use any cobalt anode at all.

MR. ROY F. CLARK: I would like to ask Mr. Proctor regarding the nickel cobalt. Of course I am a bug on bright solutions; I want my solution as bright as I can get it, and sometimes I want them hard, sometimes I want the deposit soft. But I think the addition of cobalt sort of smuts the deposit, makes it dull, does it not? And if I run my nickel solution at a low pH, I will get my bright deposit with addition agents of cadmium and gum arabic, I get the maximum brightness, no matter how long I leave them in, three, four or five hours. Sometimes I want to get that deposit so it will be bright, and yet want to bend it. It has to be bent, and I want to maintain the high lustre, yet have a deposit which will be semi-hard.

MR. PROCTOR: Well, I don't believe that cobalt will produce the results you desire. The point in the use of cobalt was simply to get a whiter nickel after it was polished. I haven't done much work on the addition of cobalt, but I would like to go back and speak about forty years ago, about the nickel anode. About forty years ago, of course we had anodes that contained cobalt. When I was connected with the Ansonia Brass & Copper Co., or the American Brass Company, we bought anodes from Ely, who was supposed to make the best, and when the anodes were left in the tank over night, they used to turn pinkish, and sometimes I used to think they contained iron or a little copper in the solution, but we know the characteristic color of cobalt salts is pink, and in those days with the use of citrates I used to think I got the most perfect white nickel coating that it was possible to obtain on lamp work, brass lamps, but we had to buff them; we didn't think anything about bright nickel deposits at that time. All we wanted was to get a good nickel deposit that would be malleable and ductile, enduring, and render itself readily adaptable to polishing. We didn't take the cobalt out of the nickel bath at that time, and maybe that 1% of cobalt in the anode helped to produce that color.

MR. OLIVER SIZELOVE: What method was used to determine the pH in these experiments, Mr. Lah?

MR. LAH: Quinhydrone.

MR. SIZELOVE: I did work with cobalt, and there is no question but that it does give you a whiter deposit of the alloy. The trouble that you have is to determine the pH, that is, with the titration method or colorimetric, because the addition of cobalt salts interferes with the end point.

THE Chicago Branch of the American Electroplaters' Society will hold its annual banquet and educational session at the Palmer House, Monroe and Wabash Avenues, Chicago, on Saturday, January 17, 1931.

The educational session is to start at 2:00 p. m. sharp. It is to be held in the foyer of the grand ballroom. The banquet is to start at 7:00 p. m.

The committee extends a hearty welcome to all platers and their friends to this affair.

CONFERENCE ON ELECTROPLATING STANDARDS

PALMER HOUSE, *Chicago, January* 17, 1931, 9:00 a.m.

All interested persons are invited to attend a conference on electroplating standards to be held at the Palmer House, Chicago, January 17, 1931, at 9:00 a.m., under the auspices of the Chicago Branch and the Research Committee of the American Electroplaters' Society. Those who expect to attend, are requested to notify Mr. Jacob Hay, 6920 Ottawa Avenue, Edison Park, Illinois, so that necessary arrangements may be made.

The following is a tentative outline for this conference.

I. PURPOSE OF CONFERENCE

To consider both the materials used in the plating industry and the plated products. To consider in each case (a) whether a specification is needed, (b) what is a reasonable basis for such a specification, (c) whether sufficient information is now available to prepare at least a tentative specification, (d) whether any existing specifications meet the need; and (e) to take steps toward the preparation and adoption of suitable specifications by the American Electroplaters' Society, in co-operation with other interested organizations.

II. MATERIALS USED IN PLATING

The specification should include (a) the minimum contents of the desired constituents, and (b) the maximum contents of any detrimental impurities. (This procedure eliminates the necessity of referring to harmless constituents). In each case the method of analysis should be included.

Three classes of materials may be considered, viz:

1—General chemicals such as nitric, sulphuric and hydrochloric acids; sodium hydroxide, carbonate, phosphate, cyanide and sulphate; potassium hydroxide and cyanide; ammonium chloride and sulphate.

2—Heavy metal compounds such as copper sulphate, carbonate and cyanide; nickel sulphate, chloride and carbonate; nickel ammonium sulphate; zinc sulphate, chloride, cyanide and oxide; cadmium cyanide and oxide; silver nitrate, chloride and cyanide; chromium sulphate and chromic acid; stannous chloride, sodium stannite and sodium stannate; gold chloride and cyanide.

3—Anodes, such as copper, electrolytic, rolled and cast; nickel, electrolytic, rolled and cast; zinc, cadmium, tin, lead, silver and gold.

III. Plated Products

In each case the specification should include (a) one or more requirements, (b) methods of test, and (c) information that will aid the plater to meet the requirements. Depending upon the coating and its intended use, the specification of the coating might be based upon one or more of the following requirements:

1—A minimum average thickness of one or more metal coatings, as determined by stripping tests.

2—Uniformity of distribution and a minimum thickness, as determined by a "spot-test" or by microscopic examination.

3—A minimum porosity, as determined by a test such as the "ferroxyl" test on steel.

4—A definite resistance to corrosion, as determined by some accelerated test such as the salt spray.

5—A definite resistance to corrosion, as measured by some hardness test such as the "scratch-hardness," or by some wear test.

6—Ductility and adhesion, as measured by some bending test.

7—Suitable *luster*, as measured by some reflection test.

The following *finishes* might be considered, with appropriate variations in the composition or thickness of any preliminary metal coatings, and with reference to typical uses and exposures.

A—*Nickel* on steel, brass, zinc, zinc die castings, and aluminum.

B—*Chromium* on steel, brass, zinc, zinc die castings, and aluminum.

C—*Zinc* on iron and steel.

D—*Cadmium* on iron and steel.

E—*Tin* on iron and steel, copper and brass.

F—*Brass* on iron and steel.

G—*Silver* on nickel brass, nickel silver, steel, and britannia metal.

IV. Consideration of Existing Specifications

In order that we may get the benefit of previous experience, all persons interested in this field, whether they expect to attend the conference or not, are requested to send any existing specifications on this subject to W. Blum, Bureau of Standards, Washington, D. C., with their comments. This information will then be compiled for consideration at the Conference, but the sources will be kept confidential if so desired.

A. E. S. PAGE

Assembled Expert Scraps With and Without Significance

A HAPPY NEW YEAR to all our readers. Now that the open season for New Year's resolutions is about to begin we wish the Secretaries of the St. Louis, Cincinnati, Dayton, Grand Rapids, Indianapolis, Pittsburgh, Providence, Montreal and Toledo branches would include in their list as follows:

Resolved, that as Secretary, I will endeavor to send the reports of the activities connected with my branch to the REVIEW every month for publication as is customary. We have been informed through the Secretary-Treasurer's office that plater's classes have been started by Dayton branch. That's good news. Here's some more. Worcester's branch held its first meeting in several months and has just sent in a report to the REVIEW. A little extra effort, and a little more co-operation, then the Roll Call of Branches will be complete.

JES' KEEP ON KEEPIN' ON

If the day looks kinder gloomy,
An' yer chances kinder slim;
If the situation's puzzlin'
An' the prospect's awful grim,
An' perplexities keep pressin'
'Till all hope is nearly gone,
Jes' bristle up and grit your teeth,
And keep on keepin' on.

Fumin' never wins a fight
An' frettin' never pays;
There ain't no good in broodin' in
These pessimistic ways.
Smile jes' kinder cheerfully
When hope is nearly gone,
An' bristle up an' grit your teeth,
An' keep on keepin' on.

There ain't no use in growlin'
An' grumblin' all the time,
When music's ringing' everywhere
An' everything's a rhyme;
Jes' keep on smilin' cheerfully,
If hope is nearly gone,
An' bristle up an' grit your teeth,
An' keep on keepin' on.

—Author Unknown.

PROGRAM

Educational Session

BALTIMORE-WASHINGTON BRANCH

HOTEL EMERSON BALTIMORE, MD.

Saturday, January 31, 1931, 2:30 p.m.

1. E. M. BAKER (University of Michigan)
   "Studies in Metal Polishing"
   (Illustrated with Slides)
2. R. J. O'CONNOR (Contract Plating Co., Bridgeport, Conn.)
   "Problems in Job Plating"
3. W. BLUM (Bureau of Standards)
   "Summary of Chicago Research Conference"
4. H. D. HUBBARD (Secretary, Bureau of Standards)
   "Recent Progress in Science"

LOS ANGELES BRANCH

The regular monthly meeting was held as usual on the 2nd Wednesday of the month at the Pig 'n' Whistle. Thirty-three sat down to a good dinner after which President, C. E. Thornton, called the meeting to order.

Mr. R. W. Boyles of Kansas City, and Mr R. A. Strahan were the visitors.

Mr. Frank C. Rushton gave a report on the General Assembly of Platers and the affair was voted a complete success.

After business affairs had been attended to, President Thornton turned the meeting over to the Librarian, Bob Gripp.

The question box contained the following:

Question—How much acid is there in one pound of Single Nickel Salts?

Answer—There is no acid in the Single Nickel Salts.

Question—What is the difference between Chromic Acid and Chromium Trioxide?

Answer—The name "Chromic Acid" is incorrect.

Question—What makes nickel anodes turn black and stop plating?

Answer—Add either sulfuric or muriatic acid.

Alex Regmunt titrated some nickel solution for metal content, and this was very interesting.

The meeting adjourned at 10:00 p.m.

M. D. RYNKOFS, *Secretary-Treasurer.*

NEW YORK BRANCH

The regular meeting of New York Branch was held at World Building, Park Row, New York City, November 14. President Haushalter presiding.

This was an open meeting and we had a very large attendance, our speaker for the evening was Dr. Anderson, who spoke on plating zinc and zinc base die castings. This was thoroughly enjoyed by the large gathering present and on conclusion of his talk many questions were asked.

He distributed a number of booklets, which gave all the formulas and means of preparing zinc for plating.

Mr. Van Deran, Past Supreme Vice President, was introduced, he addressed the audience with an account of his travels since leaving Dayton, Ohio, which was interesting and amusing.

Our second meeting was held on November 28, Dr. Sanigar, of Sheffield, England, being our speaker. His talk was on his research work in silver plating, contrasting the methods used in this country and those of England. He gave a very lengthy talk, illustrating same with lantern slides.

This was a most interesting lecture, and at the conclusion of his talk, many questions were asked which Dr. Sanigar answered in his able manner. A rising vote of thanks was given him, also to Dr. Lane who assisted at the lantern.

Question—What is a good etching medium for glass shades for lamps?

1—A solution of hydrofluoric acid and sodium or ammonium fluoride; if the etch is too coarse make a second solution more dilute.

2—A solution of hydrofluoric acid and ammonium carbonate, density, according to etch necessary.

ARTHUR GRINHAM, *Recording Secretary.*

WORCESTER BRANCH

The Worcester Branch of the American Electroplaters' Society held a meeting December 3, 1930, at the Chamber of Commerce. There were six members present and three visitors.

Mr. M. H. Frommann was appointed representative of the Branch on the Educational Bureau and also chairman of the Branch educational unit, the other members of the committee being Mr. W. J. Finnegan and Mr. J. A. Anderson. Mr. Frommann was requested to make preliminary plans for a class in chemical analysis of plating solutions and to ascertain if it would be possible to make arrangements for a small laboratory at one of the job plating shops in Worcester. He was also requested to have a report ready for the next meeting, which was held December 15, 1930.

The Secretary reported that all members were in arrears for dues and was requested to send bills to all members.

This is the first meeting that the Branch has had this fall, but it looks now as though it would show some signs of life, and you may hope to receive further word from me at more frequent intervals.

Yours very truly,

ROGER H. BRYANT, *Secretary.*

BRIDGEPORT BRANCH

On Nov 21, the Bridgeport Branch of the American Electroplaters' Society had as its speaker Mr. George B. Hogaboom, of the Hanson Van Winkle Munning Co., Matteawan, N. J., who delivered an address on the "Development of High Acid Nickel Solutions and the Heat Treatment of Chromium Deposits."

The meeting was originally scheduled for the Hammond Laboratory, Yale University, New Haven, Conn., but it was changed to Bridgeport so that the "Old Timers" Night could be held in conjunction with the lecture. Due to such a large attendance, it was necessary to shift the lecture to the Recreational Hall of the Dictaphone Co.

Some valuable information was given by Mr. Hogaboom regarding the High Acid Nickel Solutions. The advantages and disadvantages of such solutions were thoroughly outlined. In order to clearly bring out the merits of using a Nickel Solution with low P.H., the lecturer used a set of very remarkable charts. These were unique, in that actual samples of plate were plotted on the chart so that one was able to visualize immediately the type of plate that could be obtained from a solution with a certain P. H. Value, at various current densities and temperatures. Mr. Hogaboom pointed out that so-called "pitting" on work coming from such solutions was not due to hydrogen, but to impurities in the bath which were plated out—Copper being the chief offender.

With reference to the heat treating of Chromium Deposits, Mr. Hogaboom stated that this was done in order to increase their resistance to corrosion. Experiments, he stated, have shown that deposits heated for thirty minutes at 450 degrees F. would stand seven cycles in the Calcium Chloride Spray, while unheated specimens failed in one cycle. Greater corrosion resistance was attributed due to the lowering of hydrogen content of the plate.

The use of the Calcium Chloride Spray, for testing chromium plated articles, he stated, was being substituted for the Sodium Chloride Spray, for the reason that Calcium Chloride is a common constituent of road dust. It is a more severe test than the Sodium Chloride Spray, but more accurate data regarding the corrosion resistance of a plate is obtained.

Mr. Hogaboom was indebted to Mr. R. J. Wirshing and Dr. H. C. Mongey, of the General Motors Research Laboratory, Detroit, Mich., for permission to give this lecture and for the loan of the exhibits to illustrate the points discussed.

After the lecture, refreshments were served in Ray O'Connor's "Barn," and the "Old Timers" made merry. Everyone present remarked about the valuable information received at the lecture; the Bridgeport Branch expects to have more like them.

Meeting called to order at 8:30 p.m., December 5.

Roll call of officers—all present.

Attendance of about 25 members.

Minutes of last meeting read. Accepted as read.

Report of Committees:

Sick committee reported that no members were sick.

We are pleased to see Bill Stratton back again, after his severe illness. Bill better stop eating oranges.

Chemistry Class Committee Report:

There has been some delay in starting the class in chemistry, due to details that were necessary to straighten out. It is thought that during the week of December 8 the first class will be held.

Program Committee:

The secretary was instructed to send Mr. Geo. Hogaboom of the Hanson Van Winkle Munning Co. a vote of thanks for his very interesting talk of November 21, and also to send a vote of thanks to Mr. J. Luccalle for his aid in obtaining the use of the hall of the Dictaphone Co.

It was voted to hold the annual banquet of the Bridgeport Branch at Bridgeport, Conn. The date is to be announced later. President Mr. Geo. Wagstaff appointed the following banquet committee: Bill Ehrencrona, Chairman. John Oberender, Ray O'Connor, Fred Norgren, Geo. Knecht, Bill Flaherty, Bill Stratton and Ben Kuterer. Details of the banquet will be announced later.

Bill Ehrencrona finally showed up and was presented with an electric clock for his efficient services as past Secretary and Treasurer. Bill was supposed to be surprised but he read about it previously in the Review. Page Ray O'Connor.

Treasurer's report accepted as read.

Plating Problems:

Bill Ehrencrona asked the following question—Would a solution made up of Single Nickel Salts and Chromium Carbonate with 2 oz. Sulfuric Acid deposit a compound plate of Chromium and nickel? No one present thought that this would be possible.

T. H. CHAMBERLAIN, *Secretary and Treasurer.*

CLEVELAND BRANCH

The regular monthly meeting of the Cleveland Branch was held on Saturday evening, December 6, at Hotel Winton.

Vice President H. J. TerDoest called the meeting to order at 7:30 p.m.

The business of the meeting being concluded, our Librarian read a paper on the Finishing of Aluminum by R. E. Pettit.

Our fellow member Mr. Elmer Peterjohn showed samples of the different oxidized finishes he is putting on aluminum.

He was given a rising vote of thanks for his talk on the subject.

The meeting was then turned over to Mr. J. C. Mullinnix, who very capably demonstrated the following method of finding the copper content in OZS. per gal. in an acid copper, cyanide copper or brass solution.

Solutions: Standard copper sol. Dissolve 10 grams pure copper in small amount nitric acid, boil, cool, dilute to 1 liter in measuring flask. Sod. Thiosulfate: 50 grams sodium thiosulfate in 1 liter. Starch: ½ gram soluble starch in 100 cc boiling water.

Standardization: Pipette 25 cc copper sol. add ammonia till just blue, add 5 cc 80% acetic acid and 2 grams potassium iodide. Titrate with thiosulfate sol. till brown color changes to faint yellow then add 2 cc of starch sol. and titrate to cream color.

$$\text{Factor} = \frac{.250}{\text{cc of thiosulfate used.}}$$

Determination: For acid copper:

Pipette 10 cc bath and titrate as in standardization.

Ozs. per gal. equals Factor X cc of Thiosulfate used X 13.3.

Copper in Cyanide copper or Brass Sol.

Take 10 cc of bath add to sample *under a hood as gas is very poisonous* 10 cc conc. nitric acid and 5 cc sulfuric acid. Boil till heavy white fumes appear, cool and proceed as in method for acid copper.

Mr. Mullinnix was given a rising vote of thanks for his good work under trying conditions.

A motion to adjourn was carried at 10:30 p.m.

PAUL STAMM, *Secretary.*

BOSTON BRANCH

Boston Branch met Thursday, the 11th, at the American House, Boston, with President Gale in the chair.

After the regular order of business the committee on the chemistry class made a report but is incomplete as they must have more time and the branch will hold a special meeting the latter part of this month so that the committee may make its final report.

One application was received for membership which will come before the next meeting for action by the Board of Managers.

A discussion on chromium solution by the members was in order for the rest of the evening, each telling how he gets the best results and each claiming that they get the best results.

This branch would like to hear from the other branches on the question asked last meeting. Where does the sulfate in the chromium solution go? Let's hear from any of the branches.

A. W. GARRETT, *Secretary.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch A. E. S. was held Saturday, September 13, 1930 at the Atlantic Hotel. The meeting was called to order at 8:15 p.m. with President S. J. C. Trapp presiding and all officers present.

This was a very interesting meeting, the discussions were very good and Mr. J. Hay read a paper from London, England, on how they do plating over there. This was especially interesting as it gives us an idea of what our brother platers are doing across the pond.

All arrangements for the Educational Session and Dinner Dance have been completed so come out, bring your friends and help make this the best one we have held. The educational program will be of the usual high stand-

ard and microphones and loud speakers will be used so that everyone will be able to hear.

The grand ballroom of the Palmer House at Wabash Avenue and Monroe Street has been secured for Saturday, January 17, 1931. The educational session will be held in the foyer of the grand ballroom at 2:00 p.m. sharp. The dinner dance will begin at 7:00 p.m.

The committee extends a cordial welcome to all platers and their friends.

Another chemistry class is being formed. All members are invited to participate. Come to meeting and help decide what form of study shall be taken up this year. To the members of last years' class who desire further knowledge, here is an opportunity you should not pass up.

The following questions were found in the question box:

Question—Wanted to know something about chrome plating on aluminum black.

Answer—It was thought that the questioner misunderstood the finish because chrome cannot be plated on aluminum black or any other color, as this is a dye finish and is not plated on.

Question—What is the best way to plate zinc antimonial lead base metal sometimes known as unbreakable metal?

Answer—Make a dip composed of 2 oz. coppercyanide, 2 oz. sodium cyanide and 4 oz. caustic soda, heat to 150 degrees F. Dip the work in this solution just long enough to get a good copper coating then rinse and plate.

Question—What is Tudor finish?

Answer—Tudor finish is a trade name on work put out by the silver industry to distinguish it from other brands.

Question—Is it practical to line a steel tank with asphaltum for nickel plating, as lead lining is too expensive?

Answer—It is not practical to line a steel tank with asphaltum, but it was suggested that rubber lining could be used.

Question—If a copper tray is thoroughly cleaned so it will plate perfectly what is there on the surface that prevents adhesion in a hot tin bath?

Answer—There must be a film of oxide on the copper which must be removed before the tin will adhere. It was suggested that a little muriatic acid be added to the flux or add a little boric acid to the hot tin bath.

J. C. KRETSCHMER, *Secretary and Treasurer.*

WATERBURY BRANCH

The December meeting of Waterbury Branch was one of the most interesting of the season. No particular subject was assigned for discussion, but before the evening was over half a dozen plating problems provided plenty of interest for all present. The subject of a chemistry class was brought before the meeting by President Wm. Gray, and was favorably commented on. Secretary Chamberlain of the Bridgeport Branch gave an interesting account of what his organization was doing in the chemistry line. Electroplating standards was another topic touched on. Remarks on same were made by Messrs. Carlston, of Newark Branch; Downs, of New York Branch; English, of Bridgeport Branch; Gray, Candee, Mahlstedt and Crouch, of Waterbury Branch. An interesting outline on the subject of ball-

rolling as done in one of the local factories for the past twenty-eight years, was given by President Gray. Black nickel solutions and the analysis of same was another subject brought up for discussion. Announcement was made that arrangements were under way for a speaker on a subject to be announced later, at our next meeting, Friday, January 9th.

Applications for membership were received from the following: Robert R. Emminger, Chromium Corp. of America; Richard P. Crane, Lea Mfg. Co.; and Charles Raidozzi, American Fastener Co. At the conclusion of the meeting, a social time was held, refreshments being served.

W. F. GUILFOILE, *Secretary.*

DETROIT BRANCH

Detroit Branch held its regular monthly meeting Friday evening, December 5 at the Statler Hotel, President Jos. H. Hansjosten presiding. After our regular order of business we heard the report of the committee appointed by the chair to formulate plans for a class in simplified methods of analytical control of plating solutions. This class will hold its first meeting on the first Wednesday in January, at the new Wilbur Wright School equipped with one of the most up-to-date laboratories in the city and under a very able teacher. All due credit to the members of this committee Mr. Jameson and Mr. Hansjosten for their untiring efforts together with the co-operation of the Board of Education in making this class possible. The following is a brief outline of the course of study:

COPPER CYANIDE BATH.

Volumetric Determination of Cyanide Content. Also Copper Content.

NICKEL BATH.

Determination of Nickel and Chlorine Content. Also Boric Acid. Making pH measurements.

CHROMIUM BATH.

Determination of Chromic Acid and Sulphates (Gravimetric).

Question—What is the best indicator to use for getting pH2 in a nickel solution?

Answer—Thymal Blue. pH range 1.2—2.8. Dissolve 0.1 g of indicator in 50 cc 20 n. sodium hydroxide and dilute to 250 cc with distilled water and use.

Question—Is nickel plating on a cadmium deposit practical for serviceable wear?

Answer—Yes. But good cleaning before nickel plating is essential.

Question—Why does a warm nickel solution at 100° F have a greater tendency to pit than one operated at normal temperature?

Answer—Run hot solution at lower pH.

Question—How is the hydrogen sulphide test performed on brass parts which have been nickel and chromium plated?

This question was not answered. Any information on the subject will be welcome.

(Let's go, boys!)

CHAS. M. PHILLIPS, *Secretary and Treasurer.*

ROCHESTER BRANCH

Rochester Branch held its first meeting at the Hotel Seneca on Friday evening, November 21. This hotel is to be the headquarters for the National Convention which will be held in Rochester next June. This was the first step by the committee and we know that all who come to Rochester to the convention will be pleased with the service at this hotel. President Reama was in the chair at the meeting. The application of William Scott Felton was accepted, also one application was received, Mr. H. A. Gulbrandsen, now employed by the Metal Arts Co., Rochester, N. Y. The death of one of our oldest members, Mr. Adolph Wahl, was reported. We will miss Adolph Wahl as he was always ready to help any member of the A. E. S.

Rochester Branch voted to have an open meeting on January 16 at which time Mr. George B. Hogaboom will be with us and read a paper on hot nickel solutions. Mr. Hogaboom has many friends in Rochester and we know many will be on hand to hear this paper.

President Reama selected the following members as chairmen of the various committees: Entertainment and finance, Gerald A. Lux; hotel and papers, Raymond P. Lopez; registration, Judson R. Ekter; publicity, Frank J. Kohlmeier; transportation, William D. Hart; ladies' exhibit, Harry W. Puffer, S. P. Gartland; program and printing, Chas. Griffin.

On Thursday evening, December 4, at the Dutch Mill on Stone Road, the chairman of the various committees held a Kraut supper after which a business meeting was held and Mr. S. P. Gartland was elected general chairman of all committees. Mr. Gartland is well known and will keep the good work rolling along. So start to plan early to be in Rochester June 29 to July 2 as we know you cannot afford to miss this convention.

CHAS. GRIFFIN, *Secretary.*

RESOLUTION OF SYMPATHY

Whereas, it has transpired that our Brother and friend, Adolph Wahl, has by the will of Almighty God been removed from his place among us upon earth, *be it resolved,*

That we, the members of the Rochester Branch American Electroplaters' Society, herewith tender, to those loved ones that survive, our most sincere and heartfelt sympathy in their hour of great loss and bereavement occasioned them by the taking of their Husband and Father, *and be it further resolved,*

That, these resolutions be spread upon the minutes of our meeting, and a copy sent to the wife of the deceased.

AMERICAN ELECTROPLATERS' SOCIETY,
ROCHESTER BRANCH

R. P. LOPEZ,
S. P. GARTLAND,
HARRY W. PUFFER.
Committee.

HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford Connecticut Valley Branch, A. E. S. held its regular monthly meeting on Monday evening, November 24, at the Hartford Chamber of Commerce, 805 Main Street, Hartford, Conn.

The meeting was called to order at 8:15 p.m. with President Beloin in the chair. Minutes of the previous meeting were read and accepted. All bills were voted paid. One communication was read and placed on file. Two applications were received for active membership, and were voted upon for publication. The applicants were James Byrnes, Jr., of Middletown, Conn., and Edw. Condel of Westfield, Mass.

Reports in regard to the plater's class in Springfield were received from Mr. Frank Clark and Mr. Kennedy. There is much interest shown in the class and its work. The Springfield class now numbers eleven, with more prospective members. The class sponsored by the Manufacturers' Association of Hartford County, has a total of thirty-three members. A short report was made by President Beloin.

It was voted to donate the sum of fifty dollars ($50.00) to the Springfield class to help equip them with the proper equipment to conduct their class. It was also voted to hold our next meeting at the plant of T. J. Murray where the plater's class is being conducted. The meeting will be on Monday evening, December 22.

Mr. George Hogaboom was then introduced and gave a very interesting talk accompanied by fine samples, on "The History of Silver Plating on Glass and China." The boys who missed this talk, certainly missed a treat, for it was one of the best and most interesting talks that we have had in a long while.

Mr. Hogaboom was assisted by Mr. Turner, who has charge of this type of work for the Rockwell Silver Company of Meriden, Conn.

Mr. Hogaboom gave us a fine talk on some of the plating problems as met and overcome twenty-five years ago. In conclusion, he was given a rising vote of thanks.

The meeting was attended by thirty-two members and visitors, and was adjourned at 10:45 p.m.

VERNON E. GRANT, *Secretary.*

MISTAKES

"There are seven mistakes of life that many of us make," said a famous writer and then he gave the following list:

"The delusion that individual advancement is made by crushing others down.

"The tendency to worry about things that cannot be changed or corrected.

"Insisting that a thing is impossible because we ourselves cannot accomplish it.

"Refusing to set aside trivial preferences in order that important things may be accomplished.

"Neglecting development and refinement of the mind by not acquiring the habit of reading.

"Attempting to compel other persons to believe and live as we do.

"The failure to establish the habit of saving money."—*Seamen's Log.*

HOME SENTIMENT

A London paper offered a prize for the best definition of home. Here are some of the answers sent in:

The golden setting in which the brightest jewel is "mother."

The world of strife shut out, a world of love shut in.

An arbor which shades when the sunshine of prosperity becomes too dazzling; a harbor where the human bark finds shelter in the time of adversity.

Home is the blossom of which heaven is the fruit.

Home is the person's estate obtained without injustice, kept without disquietude; a place where time is spent without repentance, and which is ruled by justice, mercy and love.

A grand old mirror, through which both sides of us are seen.

That source of comfort which youth does not fully appreciate, which the young men and maidens loving desire, which the middle-aged generally possess, which the old rightly value.

A hive in which, like the industrious bee, youth garners the sweets and memories of life for age to meditate and feed upon.

The best place for a married man after business hours.

Home is the cosiest, kindliest, sweetest place in all the world, the scene of our purest earthly joys and deepest sorrows.

The only spot on earth where the faults and failings of fallen humanity are hidden under the mantle of charity.

The place where the great are sometimes small and the small are often great.

The father's kingdom, the children's paradise, the mother's world.

The jewel casket containing the most precious of all jewels—domestic happiness.

Where you are treated best and you grumble most.

Home is a central telegraph office of human love, into which run innumerable wires of affection, many of which, though extending thousands of miles are never disconnected from the one great terminus.

The center of our affections around which our hearts' best wishes twine.

A little hollow scooped out of the windy hill of the world, where we can be shielded from its care and annoyances.

A popular but paradoxical institution, in which woman works in the absence of man, and man rests in the presence of woman.

A working model of heaven, with real angels in the form of mothers and wives.

The place where all husbands should be at night.—*Selected.*

A MAN'S CREED

Let me live, O Mighty Master,
  Such a life as men should know,
Tasting triumph and disaster—
  Joy—but not too much of woe.
Let me run the gamut over,
  Let me fight and love and laugh,
And when I'm beneath the clover,
  Let this be my epitaph:
Here lies one who took his chances
  In the busy world of men;
Battled luck and circumstances;
  Fought and fell and fought again;
Won sometimes, but did no crowing,
  Lost sometimes, but did not wail;
Took his beating but kept going;
  And never let his courage fail.

—Anonymous.

YOU

You are the fellow who has to decide
Whether you'll leave it or toss it aside.
You are the fellow who makes up your mind
Whether you'll lead or will linger behind,
Whether you'll try for the goal that's afar
Or be contented to stay where you are.
Take it or leave it. There's something to do.
Just think it over. It's all up to you.

—Selected.

APPLICATIONS

	Branch
James Byrnes, Jr., Middletown, Conn. (Active)	Hartford-Conn. Valley
Edw. Condel, Westfield, Mass. (Active)	Hartford-Conn. Valley
H. A. Gulbrandsen, Rochester, N. Y.	Rochester
Lewis E. Rose, 1120 Taylor St., Fort Wayne, Ind.	

ELECTIONS

	Branch
Albert Leimer, 591 E. 4th St. Santa Anna, Calif. (Active)	Los Angeles
Chas. F. Heines, 1015 Summit Ave., New York	New York
Philip Lopiesti, 352 S. Main St., Seymour, Conn.	Waterbury
John N. Mesek, 87 Frary Ave., Meriden, Conn.	Waterbury
Wm. V. Coleman, 32 Giles St., Waterbury, Conn.	Waterbury
John Westley Ruby, Oak St., Newcomerstown, Ohio	Dayton
Wm. Scott Felton, Rochester, N. Y.	Rochester
Morris Brown, 420 9th Ave. (Asso.) La Grange, Ill.	
Russell Harr, 119 Parkside Ave. (Asso.) Chicago, Ill.	
Marion Longfield, 1321 S. 59th Ave. (Active) Cicero, Ill.	

REINSTATEMENTS

	Branch
Lewis Graham, 536 Lyons Ave., Irvington, N. J.	Newark
August Hoffman, 920 Summit Ave., Jersey City, N. J.	Newark

TRANSFERS

	Branch
R. E. Pettit (Asso.)	from New York to Rochester
A. Metheviev	from Chicago to Los Angeles

DEATHS

	Branch
Adolph Wahl, Rochester, N. Y.	Rochester

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Other Branch Representatives will be printed as received.

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Meets in Enoch Pratt Library, Calhoun and Hollis Sts., Irvin H. Hahn, Secretary, 201 S. Sharp St., Baltimore, Maryland.

BOSTON

Meets at American House, Boston, Mass. First Thursday each month. Secretary A. W. Garrett.

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Meets first and third Friday of each month at Chamber of Commerce Rooms, Stratfield Hotel. Secretary, T. H. Chamberlain, 859 Orange St., New Haven, Conn.

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Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 216 S. Clark St. Secretary, J. C. Kretschmer, 1914 Warner Ave.

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Meets every Thursday, 7:30 p. m., at Vocational Training School, Spring and Liberty Sts. Secretary, Al Yeager, 2021 Sherman Ave., Norwood, Ohio.

CLEVELAND

Meets first Saturday of each month at Hotel Winton, Paul R. Stamm, Secretary, 947 Elson Road, Cleveland Heights, Ohio.

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Meets fourth Monday in each month alternately at the Chamber of Commerce 815 Main St., Hartford and the Chamber of Commerce 134 Chestnut St., Springfield. Secretary Vernon Grant, 43 Putnam St., Bristol, Conn.

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Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Robert G. Suman, 2734 Ridge Road, Dayton, Ohio.

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Meets every second and fourth Fridays of each month in the World Building, Park Row, New York City, N. Y. Secretary-Treasurer, J. E. Sterling, 2561 46th St., Astoria, L. I.

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Meets first Thursday of each month at Toledo Secor Hotel, corner Cherry and Page Streets. James M. Lee, Secretary, Barker Street, Fremont, Ohio.

TORONTO

Meets fourth Monday of each month at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, H. W. Graham, 102 Robina Ave., Toronto, Canada.

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Meets the second Friday of the month at Engineers Hall, No. 11 East Main Street. Wm. F. Guilfoile, secretary, P. O. Box 961, Waterbury, Conn.

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Meets Directors' Room, Chamber of Commerce, Worcester, Mass. Roger H. Bryant, Secretary, 94 Grove St., Worcester, Mass.